[This question paper contains 6 printed pages]

Your Roll No .

5806 **J**

B.Sc (Hons)/III

BIOCHEMISTRY—Paper XI

(Molecular Biology—I)

(Admissions of 2000 and onwards)

Time 3 *Hours* *Maximum Marks* 60

(Write your Roll No on the top immediately on receipt of this question paper)

Attempt **five** *questions in all, including*

Question No 1 *which is compulsory*

1 (A) Explain the following observations $2 \times 5 = 10$

(i) Transposition invariably produces direct repeats in the chromosomal DNA

(ii) Human trisomies 13, 18 and 21 can survive but other autosomal trisomies are lethal

(iii) Tautomerisation of bases can contribute to mutations

(iv) Positively supercoiled DNA does not exist in nature

(v) Sometimes females heterozygous for X-linked color blindness are color blind in one eye and have normal vision in the other eye

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(B) (i) Linking number, twist and writhe of a relaxed 312 bp B-DNA

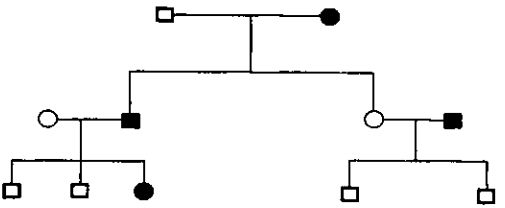
(ii) Tm of a given DNA sequence

5'TAA TACGA CTCACT ATAaaa 3'

$2 \times 3 = 6$

2 (a) A human disease known as cystic fibrosis is inherited as a recessive trait A normal couples first child has the disease What is the probability that the next two children will not have the disease?

What is the most likely pattern of inheritance in the given pedigree



2

(b) Joe has classic hemophilia, an X-linked recessive disorder What is the likelihood (in Yes or No) that Joe has inherited the defective gene from the following ?

(i) His mother's mother

(ii) His father's mother

(iii) His mother's father

(iv) His father's father

Defend your choice 3

(c) Differentiate between the following pairs

(i) Physical map distance and Genetic map distance.

(ii) Specialized and generalized transduction F^+ and F' bacterial strains $2 \times 3 = 6$

3 (a) An unaffected woman who is heterozygous for the X-linked trait Duchene's muscular dystrophy has children with a normal man. What are the probabilities of the following combinations of offsprings?

(i) An unaffected son

(ii) An unaffected daughter

(iii) A family of three children, all of whom are affected $1 \times 3 = 3$

(b) A cross was made between flies homozygous for normal alleles

St^+ (red eyes). Ss^+ (spiny), e^+ (gray body) and flies homozygous for recessive alleles St (scarlet eyes), Ss (spineless), e (ebony body) The F_1 generation so produced was test-crossed and the proportion of phenotypes produced in the progeny is given as

Red eyes, gray body, spiny 283

Scarlet eyes, ebony body, spineless . 278

Red eyes, gray body, spineless 5

Red eyes, ebony body, spineless 50

Scarlet eyes, gray body, spiny 52

Scarlet eyes, ebony body, spiny 3

Scarlet eyes, gray body, spineless 41

Red eyes, ebony body, spiny 43

(i) Give the gene order 2

(ii) Calculate map distances between these genes 3

(c) What is familial Down's syndrome? What type of chromosomal aberration accounts for it? 3

4 (a) What is the genetic basis of Bombay phenotype ? 2

(b) In E coli, the following cross is carried out

Hfr lac^+ gal^+ trp^+ his^+ str-s × F^- lac^- gal^- trp^- his^- str-r

Using each of the markers in turn as selected marker and str as counter-selected marker, what medium should you use for each of the following purposes

(i) To select for lac^+ and counter select for str-r

(ii) To select for trp^+ and counter select for str-r 2

(c) Explain the inheritance of leaf coloration in Mirabilis jalapa (4 O'clock) 3

(d) Explain how the difference in dosage of X-linked genes compensated in mammalian females 4

5 (a) Transposons mediate rearrangement of host DNA Justify 4

(b) Give the contributions of the following scientists and discuss their experiments in brief $2 \times 2 = 4$

(i) John Cairns

(ii) Messelson & Slahl

(c) What is the underlying genetic defect that causes xeroderma pigmentosum? How can the symptoms of this disease can be explained by the genetic defect ? 3

6 (a) Give the functions of the following proteins

(i) Primase, (ii) DNA ligase, (iii) β-sub-unit of DNA polymerase III, (iv) Helicase, (v) PCNA 5

(b) How replication is initiated in K Coli 3

(c) What is an Okazaki fragment? In which strand of DNA these fragments are formed? Why is it necessary to make these fragments ? 3

7 (a) How does the formation of Halfday intermediates in homologous genetic recombination differ from their formation in site specific recombination? 5

(b) What is the link between telomers, cell senesence and cancer? What will be the consequences if telomerase is not functional? 4

(c) During mismatch repair, why is it necessary to distinguish between the template strand and the newly made complementary strand? How is this accomplished ? 2

8 Write short notes on the following

(i) Genomic Imprinting 3

(ii) Overdominance 2 5

(iii) Fidelity of DNA replication 3

(iv) Stabilization of double helix 2 5